MAGNETIC CLOSURE

FIELD OF INVENTION

The present invention relates generally to closure devices and more particularly to a magnetic closure device wherein a magnetic force is established in a plane substantially parallel to the plane of a flexible panel having an edge defining a border of the closure.

BACKGROUND OF THE INVENTION

Many devices have been developed for closures for openings having a longitudinally extending boundary that is defined by a border of at least one flexible panel member. Such closure devices have typically been in the form of buttoms, buckles, clasps and slide fasteners, particularly of the zipper type. In order for an object to move through an opening formed by a typical prior art closure device of the above-mentioned type, the closure device must be mechanically manipulated throughout the length of the opening. After the object has moved through the opening, the closure device must again be mechanically manipulated. For certain types of openings, such as openings through the flaps or front panels of a tent, where it is necessary to open and close a pair of closure devices generally extending at right angles to each other each time ingress and egress to the tent occurs, the mechanical manipulation can be time consuming and bothersome. For a tent closure, where it is imperative to provide as effective a closure as possible at all times in order to keep insects from the interior of the tent, mechanical manipulation of the closure is frequently difficult because articles carried in both hands are frequently brought through the closure device.

In an attempt to avoid the mechanical manipulation required of typical prior art closure devices of the type specified supra, magnetic closure devices have been proposed. The proposed magnetic closure devices have generally involved permanent magnets arranged so that a magnetic force is provided in a plane at right angles to the plane of a panel forming the closure. The magnetic force is directed toward a corresponding magnetic attractive member on a second panel; corresponding elements may be either a permanent magnet or an element having high magnetic permeability. The two panels are thereby in generally abutting relationship with an overlapping portion in the region where the permanent magnet holds the two panels together. Because of the overlapping region between the two panels, easy access through the opening in both directions is not provided. If one panel has two degrees of freedom of movement so that its faces can contact one or the other face of the other panel, the closure may not be effected at all. This is particularly true if both pole areas are on the same face of the permanent magnet, since one face of such permanent magnets is generally polarized to a much greater extent than the other face. If the permanent magnet is polarized through its width, so that the two faces thereof are oppositely polarized, a proper seal may not be provided because magnets along different portions of the closure region might have a tendency to cause opposite faces of the two panels to abut against each other. Hence, along a first portion of the seal the abutting faces of the two panels could be one pair of faces and along a second portion of the seal the abutting faces could be the faces

on the opposite sides of the panels. In such a situation, a hole would be left in a transition region between the first and second portions of the seal.

BRIEF DESCRIPTION OF THE INVENTION

In accordance with the present invention the overlap problems of prior art magnetic closure devices are avoided by including permanent magnet means that establishes magnetic forces across a boundary of the closure in a plane substantially parallel to a plane of a first flexible panel. Magnetic force attractive means on a border of a second panel or member responds to the magnetic forces to hold the two borders in abutting relationship without overlap between the panels. Because the borders are in abutting, non-overlapping relationship, movement of an object through the closure device in either direction is facilitated.

If the two borders are vertically disposed they have an apex at an upper portion thereof. Thereby, when the flexible panel is being closed, it returns initially by gravity toward the other panel and the permanent magnets provide horizontal forces that thereafter bring and hold aligned segments of the two borders in contact. Successive portions of the two borders contact each other, with the portions closest to the apex generally contacting each other before the portions more remote from the apex.

By providing the magnetic force in a plane substantially parallel to the plane of the flexible panel and utilizing bar magnets having poles at opposite ends of the bar on a front face abutting the boundary, the front faces of the permanent magnets always provide the strong magnetic field necessary to establish alignment of the panels across the boundary. Alignment is thereby achieved regardless of the relative initial position of the faces of the flexible panel relative to the faces of the other member. This is in contrast with the prior art magnetic closures, as discussed supra.

Another feature of the invention relates particularly to closures having boundaries defined by a pair of intersecting slits that run in different directions, such as in a tent where there are a downwardly extending center slit and a horizontally extending slit that runs in proximity to the ground from the center slit toward the outer periphery of the tent. In accordance with this feature, the center slit is closed by the previously discussed mechanism while the horizontally extending slit is closed by a vertically directed magnetic force formed by a permanent magnet included either in a threshold running in the horizontal direction or in the horizontally extending portion of the panel. The vertical magnetic force across the horizontally extending slit extends in a direction parallel to the plane of the flexible panel which engages the threshold. In operation, as the closure is sealed along the vertical slit in response to the gravitational and horizontally directed magnetic forces, the panel is secured in situ to the threshold by the vertically directed magnetic forces established between magnetic elements that extend along the horizontally extending slit.

To enable the flexible panel to retain its flexibility, the magnetic elements therein, whether they be permanent magnets or elements of high magnetic permeability, are arranged so that there are gaps between the magnetic fields of adjacent magnets. The gaps can be provided by spacing the permanent magnets or magnetic elements of high magnetic permeability, or by